

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Norival Figueira, et al. Examiner: C. Patel
Serial No.: 10/718,129 Art Unit: 2616
Filed: November 20, 2003 Attorney Docket No.: 14715SSUS03U
Title: METHOD AND APPARATUS FOR DIRECT FRAME SWITCHING USING
FRAME CONTAINED DESTINATION INFORMATION

CERTIFICATE OF ELECTRONIC TRANSMISSION

I hereby certify that this document, along with any other papers referred to as being attached or enclosed, is being filed electronically on September 30, 2008.

/John C. Gorecki/
John C. Gorecki, Reg. No. 38,471

M.S. Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF

(i) Real Party In Interest

This application is owned by Nortel Networks, Limited, of St. Laurent, Quebec, CANADA.

(ii) Related Appeals and Interferences

None

(iii) Status of Claims

Claims 1-10 and 15-22 are pending in the application and stand rejected. Claims 11-14 and 23 have been canceled. The following rejections are appealed:

The rejection of claim 10 under 35 USC 101;

The rejection of claims 1, 3, 5, 6, and 10 under 35 USC 102(e);

The rejection of claims 15, 16, and 19 under 35 USC 102(e); and

The rejections of claims 2, 4, 7-8, 9, 17-18, 20, 21-22 under 35 USC 103.

(iv) Status of Amendments

The proposed amendment to claim 10 submitted in an Amendment After Final dated May 1, 2008 has not been entered. There are no other un-entered amendments.

(v) Summary of Claimed Subject Matter

This application relates to a way to allow a switch to directly identify the output port for a given frame without performing a table access operation. (Specification at Paragraph 18). In a conventional layer 2 switch using common layer 2 forwarding techniques, a switch learns MAC addresses of attached network elements and creates a table of destination MAC addresses and output port IDs (forwarding table) so that the switch can forward frames to the proper destination ports. (Specification at paragraph 7). When a frame is received, the destination MAC address of the frame is read and the switch will perform a lookup operation in the forwarding table to determine the output port for the frame. Id.

Since there are several drawbacks to this conventional approach (see Specification at paragraph 8), applicants sought to find a new way to forward frames on a network. Specifically, applicants discovered that it would be advantageous to provide a frame with frame contained destination information that would allow one or more switches on the network to receive the frame, look at the destination information, and output the frame on a correct port to that destination without requiring the switch to perform a table lookup. (Specification at paragraph 9)

One of the ways that applicants proposed to do this, was to use the portion of the header normally used as the destination MAC address to contain source routing information that would specify a particular path through the switches on the local network. In this embodiment, rather than look at the whole destination MAC address (DA) and perform a FIB lookup based on the DA, the switches would look at a particular field within the DA and switch based on that content of that field. (See e.g. specification at paragraphs 18, 26). By way of reference, a standard DA has six bytes (See Specification Fig. 2). Conventionally, a switch would read the whole DA and look at a table to determine the output port for a packet. Applicants proposed to assign multiple bit fields of the six byte DA to particular switches, which would allow each switch to only read

its assigned field and make a forwarding decision based on the content of that field. (See e.g. Specification at Fig. 3).

The following tables map support in the specification to the claim limitations:

Independent Claim 1:

Claim limitation	Support
1. A method of switching frames at a first switch on a communication network, comprising the steps of:	Fig. 1, Fig. 4
receiving a frame at a first switch;	Paragraph 38
extracting frame contained destination information from the received frame;	Paragraph 38
making a switching decision within the first switch based on the extracted frame contained destination information without performing a lookup in a forwarding table to determine an output port from the first switch over which the frame should be forwarded onto the communication network;	Paragraphs 30, 43-44, 49
forwarding the frame within the switch to the output port over which the frame should be forwarded onto the communication network; and	Paragraph 32
transmitting said frame from the determined output port onto the communication network;	Paragraph 32
whereby a received frame may be transmitted from an input port to a determined output port and then onto the communication network based on the frame contained destination information without performing a table lookup operation to determine the output port.	Paragraphs 30, 32

Independent Claim 10:

Claim limitation	Support
10. A protocol data unit data structure stored in a tangible computer readable medium, the protocol data unit data structure comprising:	Fig. 3; Fig. 5 ASIC 78=tangible computer readable medium
a destination Media Access Control (MAC) address, the destination MAC address being a local MAC address having a plurality of fields, each of the fields including a number of bits smaller than a total number of bits of the destination MAC address, and each of the fields containing a code to be used by a switch on a network to identify an output port on the switch without performing a table lookup operation to enable the switch on the network to make a forwarding decision for the protocol data unit, wherein each of the fields is to be used by a different switch on the network; and	Fig. 3; Paragraph 26
a payload portion.	Paragraph 37

Independent Claim 15:

Claim limitation	Support
15. A method of assigning a Media Access Control (MAC) address to an interface on a network, comprising:	Paragraphs 29-33
setting a local bit in the MAC address to indicate to network elements on the network that the MAC address is locally assigned; and	Fig. 3 shows local bit; Paragraphs 24-25
assigning a first value to a first field of the MAC address, the first field containing a smaller number of bits than a total number of bits of the destination MAC address, said first value containing first output interface information usable by a first switch to identify a first output interface for transmission of frames containing the first value in the first	Fig. 4 Paragraphs 26 and 29-33

field of said MAC address.	
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(vi) Grounds of Rejection to be Reviewed on Appeal.

Whether claim 10 recites statutory subject matter under 35 USC 101.

Whether claims 1, 3, 5, 6, and 10 are unpatentable under 35 USC 102(e) as anticipated by Schaub (U.S. Patent No. 7,190,695).

Whether claims 15, 16, and 19 are unpatentable under 35 USC 102(e) as anticipated by Pearce (U.S. Patent No. 6,556,574).

Whether claims 2, 4, 7-8, 9, 17-18, 20, 21-22 are unpatentable under 35 USC 103.

(vii) Argument

Claim 10 -- Rejection under 35 USC 101

Claim 10 was rejected under 35 USC 101 as being directed to non-statutory subject matter. Specifically, the Examiner has taken the position that a protocol data unit is a data structure, which is not capable of causing any functional change in the computer and thus does not produce a useful result.

MPEP 2106 sets forth the analysis that an Examiner must undergo to find a claim unpatentable under 35 USC 101. According to MPEP 2106(C)(2), a claim recites patentable subject matter when it produces a useful, concrete and tangible result. The Examiner has taken the position that claim 10 does not recite a useful result (Office Action dated January 31, 2008 at page 3, paragraph 1).

According to MPEP 2106(C)(2) for a claim to recite a useful result, the utility of the invention has to be (1) specific; (2) substantial; and (3) credible. Claim 10 recites a protocol data unit data structure stored in a tangible computer readable medium. The data structure is recited as having a plurality of fields, "each of the fields containing a code to be used by a switch on a network to identify an output port on the switch without performing a table lookup operation." (emphasis added). This is the recitation of a useful result. Specifically, the data structure contains information that allows a switch to identify an output port. Thus, claim 10 recites a functional change in the computer and, accordingly, is statutory.

The Examiner stated in the Office Action dated January 31, 2008, that putting a data structure on a computer readable medium does not make it statutory "because a protocol data

unit on a computer readable medium is not capable of causing any functional change in the computer [and] thus does not produce a useful result.” This is both factually and legally incorrect.

From a factual standpoint, the claim explicitly recites the change that occurs in the computer – the fields of the data structure allow the switch to identify an output port on the switch. The identification of an output port in a network element is one of the primary functions of the network element. When a packet arrives, it is stored in temporary memory as a data structure, and the network element will read one or more of the fields of the packet to determine how to process the packet. Determination of the output port is one of the functions performed by the network element. Accordingly, the one or more fields does cause a functional change in the network element since it enables the network element to determine an output port. Accordingly, the Examiner erred, as a factual matter, by ignoring this functional change.

As a legal matter, it is well established that functional descriptive material including data structures and computer programs are patentable, when stored on a computer readable medium. See MPEP 2106.01. In claim 10, the data structure is defined as being stored in a tangible computer-readable medium. This data structure has fields that are designed to support specific data manipulation functions, i.e. to enable the network element to identify an output port. Accordingly, from a legal standpoint, claim 10 recites functional descriptive material which renders it patentable.

In the Advisory Action the Examiner stated that claim 10 was not statutory because:

“the data structure itself cannot produce any useful result. A data structure on a computer readable medium cannot cause the functionality to occur until a software or hardware makes use of such data structure. Therefore a data structure is an abstract idea and is unable to cause any change in the functionality of the device...”

Applicants respectfully submit that the Examiner has erred in this regard.

The recited data structure has fields that are readable by a switch to enable the switch to perform the function of identifying an output port. Thus, the tangible computer readable medium is formatted to change the function of the processors operating in the network element. Just like software changes a general purpose machine into a specific purpose machine, so too does the recited data structure change the functional performance of the network switch from a generic

switch to a switch that is configured to output a particular packet from a particular identified port.

The fact that the data structure cannot cause anything to occur until software or hardware makes use of the data structure is irrelevant. The same thing could be said about software on a disk since the software will not cause anything to occur until it is loaded onto the computer processor. However, it is well settled that software stored on a computer readable medium is patentable subject matter. Accordingly, the Examiner's statement that a data structure does not cause anything to occur misses the point. The point is not whether the data structure is causing anything to occur, but rather whether the data structure is capable of producing a useful, concrete and tangible result. In this instance, claim 10 clearly recites a useful, concrete and tangible result. Accordingly, the rejection of claim 10 under 35 USC 101 should be reversed.

Claims 1, 3, 5, and 6 – rejection under 35 USC 102 over Schaub

Claims 1, 3, 5, and 6 were rejected under 35 USC 102(e) as anticipated by Schaub (U.S. Patent No. 7,190,695).

Schaub addresses how packets in an incoming packet stream may be distributed to multiple parallel slower streams for processing within a network element. This is commonly referred to as link aggregation. In link aggregation, an aggregation function is related to taking packets from multiple slower links and putting the packets onto a faster link. In the reverse direction, a distribution function is used to take packets off a higher bandwidth link and distribute the packets to the lower bandwidth links. (see Schaub at Col. 1, line 62 to Col. 2, line 6).

Schaub explains that there are different types of packet flows, some of which contain packets that may be processed out of order and others of which contain packets that must be processed in-order. (Schaub at Col. 2, lines 10-17). Schaub proposes to classify packets prior to distributing the packets by the distribution function, so that “in-order” packets are sent to the same lower bandwidth link for processing within the network element while other packets are distributed among the lower bandwidth links in a round-robin fashion to perform load balancing between the available links. (Schaub at Col. 3, lines 33-41).

The categorization is used by the distribution function to forward the packet to one of the several processing paths within the switch/router. For example, in Fig. 3 of Schaub, a 10 GB

Ethernet stream is received by a PHY 310, and then passed to a packet distributor 312. The packet distributor splits the packet stream into ten 1GB Ethernet streams which are then individually processed by 1GB MAC 314 and 1 GB packet processors 316. After processing, the packets are sent to a switch fabric 318.

The Examiner indicated that Schaub taught “making a switching decision... to determine an output port from the first switch over which the frame should be forwarded onto the communication network” citing Col. 7, lines 47-62 and Col. 9, lines 21-41. Both of these sections relate to the distributor making classification decision to forward packets to the internal processors (314, 316). This is unrelated to making a switching decision to determine an output port from the first switch over which the frame should be forwarded onto the communication network. Note, for example, in Fig. 3 the packets are sent from the packet distributor to the processors 314, 316, and then to the switch fabric 318. The distributor is not making a switching decision that relates to selecting an output port, but rather is selecting an internal processing channel for the packets. Each of the processors will then make a forwarding decision to select an output port for the packets by performing a table lookup. (See Schaub at Col. 5, lines 42-51)

Fig. 5 of Schaub is identified as a “packet distributor.” (Col. 7, lines 23-25). At Col. 7, lines 47-62, Schaub teaches that packets which are to be provided to the packet categorizer 530 are first passed to a parser 540 which looks at fields of interest such as the MAC addresses, IP addresses, etc. This does not mean that the packet distributor is making decisions related to the output port from the first switch, however. Rather, the packet distributor is making a decision as to how the packets should be handled within the network element – i.e. which parallel path within the network element should be used to process the packets before forwarding the packets to the switch fabric. Each packet processor then makes forwarding decisions for the packets that are assigned to it by performing a standard FIB lookup. (See Schaub at Col. 5, lines 42-51 – MACs 314 read the layer 2 headers and perform layer 2 look-ups to determine how to forward the incoming packets...”). Thus, this portion of Schaub teaches distributing packets within the switch, so that different portions of the incoming packet stream may be processed by different MAC processors. Each of the MAC processors then performs a standard FIB lookup to forward the packet. Thus, this portion of Schaub does not teach or suggest the claimed feature of “making a switching decision within the first switch based on the extracted frame contained destination information without performing a lookup in a forwarding table to determine an

output port from the first switch over which the frame should be forwarded onto the communication network" as claimed,

In the Advisory Action the Examiner stated that Schaub teaches that frames are forwarded without doing a table lookup since the output scheduling is done in a round-robin manner either packet by packet or by groups of packets and output port is selected in this manner without doing any table lookup. The statements made by the Examiner in the advisory action appear to relate to the distribution function which, as discussed above, is used by Schaub to select an internal MAC processor. Each of the internal MAC processors then reads the MAC addresses of the packets that it has been assigned to determine output ports for the packets. Accordingly, just because a packet is assigned to a particular internal MAC processor does not mean that it is going to be output over a particular port. Rather, once a packet is assigned to an internal MAC processor, the MAC processor will perform a table lookup to determine the output port. Thus, the packet distributor has nothing to do with selecting output ports for the packets.

The Examiner also cited Col. 9, lines 21-41 (See Office Action dated January 31, 2008 at page 3). In this portion of Schaub, Schaub teaches that the load balancing unit distributes packets among multiple output links. This section of Schaub, like the first cited section, relates to how the packet distributor 512 should divide an input high bandwidth stream of packets to multiple lower bandwidth processing streams within the switch/router, and is not addressing how a switching decision should be made to "determine an output port from the first switch over which the frame should be forwarded onto the communication network" as claimed (emphasis added). Accordingly, this portion of Schaub also does not teach or suggest this aspect of claim 1.

Accordingly, applicants respectfully submit that the Examiner erred by rejecting claim 1 under 35 USC 102. Specifically, Schaub does not show (1) "making a switching decision ... based on the extracted frame contained destination information without performing a lookup in a forwarding table to determine an output port from the first switch over which the frame should be forwarded onto the communication network;" such that (2) "a received frame may be transmitted from an input port to a determined output port and then onto the communication network based on the frame contained destination information without performing a table lookup operation to determine the output port." (emphasis added). Schaub clearly performs a FIB lookup to determine the output port (Schaub at Col. 5, lines 42-51). Accordingly, Schaub does not anticipate this claim.

Claim 10 – rejection under 35 USC 102 over Schaub

In connection with Claim 10, the Examiner indicated that Schaub taught a protocol data unit data structure having a destination MAC address having a plurality of fields, citing Col. 7, lines 47-56. Schaub does not teach or suggest a destination MAC address that has a plurality of fields which are individually relevant. Rather, Schaub teaches a standard MAC address. The processor 110B obtains a HASH from a header of a received packet and uses this HASH plus a destination address to determine how to handle the packet. This is not the same as looking into the MAC address for a particular field within the MAC address and forwarding based on the content of that particular field. Accordingly, applicants also submit that independent claim 10 is not anticipated by Schaub.

Claims 15, 16, and 19 – rejection under 35 USC 102 over Pierce

Claims 15, 16, and 19 were rejected under 35 USC 102(e) as anticipated by Pearce (U.S. Patent No. 6,556,574).

Claim 15 recites a method of assigning a Media Access Control (MAC) address to an interface on a network, comprising the step of “assigning a first value to a first field of the MAC address, the first field containing a smaller number of bits than a total number of bits of the destination MAC address, said first value containing first output interface information usable by a first switch to identify a first output interface for transmission of frames containing the first value in the first field of said MAC address.” Pearce does not teach that a field, within the DA and having a smaller number of bits than the DA, should have significance to determining an output port.

In connection with this rejection, the Examiner cited Fig. 6A, element 604, of Pearce. Element 604 of Fig. 6A shows the first byte of a standard MAC Destination Address (DA). As shown in Fig. 6A, the first byte of a MAC DA contains a bit 602 indicating whether the address is an individual or group address (i.e. multicast designation) and a second bit indicating whether the DA is a local or universal MAC DA. These bits are also shown in the MAC address format of Fig. 3 of the specification of this application.

Although these fields do contain a smaller number of bits than the entire DA, they do not contain a first value containing first output interface information that is usable by the first switch to identify a first output interface as claimed.

In connection with this last element, the Examiner cited Col. 20, lines 10-18. This portion of Pearce relates to Fig. 10, which is a detailed view of an ARP table 10,000 maintained by a router 130. (Pearce at Col. 19, lines 65-67). The ARP table contains the MAC address 902 and Routing Information Field (RIF) information 904 for each End Station Port (ESP) route. As shown in Fig. 3, the Routing Information Field (RIF) information is contained in the header as a separate field 308 from the destination MAC address.

At Col. 20, lines 10-19, Pearce explains that an end station may have separately addressable ports which have different MAC addresses. This does not mean that Pearce is proposing to assign different values to different fields of the MAC address as claimed in claim 15. Rather, this portion of Pearce explains how rows of the ARP table may contain a binding between MAC addresses and end station ports, as well as the Routing Information Field information for the route to the end station port.

In the Advisory Action, the Examiner stated that ARP table in Fig. 10 teaches addressing the ports and assigning MAC addresses to ports. This assignment is used to identify the output ports that will be used with a given MAC address. The Examiner is correct that Pearce teaches assigning MAC addresses to ports, and storing the MAC addresses in an ARP table. However, that is not what is recited in claim 15. Claim 15 recites assigning a value to a field of the MAC address, and that the field contains “a smaller number of bits than a total number of bits of the destination MAC address.” Pearce does not do this, but rather uses normal MAC address assignment. Accordingly, applicants respectfully submit that Pearce does not anticipate claim 15 of this application and that the rejection of claims 15, 16, and 19 under 35 USC 102 should be reversed.

Claims 2, 4, 7-8, 9, 17-18, 20, 21-22 – rejections under 35 USC 103

The Examiner rejected several dependent claims as unpatentable under 35 USC 103 over Schaub or Pierce in view of one or more secondary references. Since the underlying interpretation of the Schaub and Pierce references does not sustain the Examiner’s rejection under 35 USC 102 as discussed above, the rejection of the dependent claims under 35 USC 103 should be reversed as well.

(viii) Claims Appendix

An appendix containing the current version of all pending claims is attached.

(ix) Evidence Appendix

None.

(x) Related Proceedings Appendix

None

Conclusion

Applicants respectfully request that the appealed rejections be reversed.

If any fees are due in connection with this filing, the Commissioner is hereby authorized to charge payment of the fees associated with this communication or credit any overpayment to Deposit Account No. 502246 (Ref: NN-14715).

Respectfully Submitted

Dated: September 30, 2008

/John C. Gorecki/
John C. Gorecki, Reg. No. 38,471

Anderson Gorecki & Manaras LLP
P.O. Box 553
Carlisle, MA 01741
Tel: (978) 264-4001
Fax: (978) 264-9119

APPENDIX – PENDING CLAIMS

1. A method of switching frames at a first switch on a communication network, comprising the steps of:

receiving a frame at a first switch;

extracting frame contained destination information from the received frame;

making a switching decision within the first switch based on the extracted frame contained destination information without performing a lookup in a forwarding table to determine an output port from the first switch over which the frame should be forwarded onto the communication network;

forwarding the frame within the switch to the output port over which the frame should be forwarded onto the communication network; and

transmitting said frame from the determined output port onto the communication network;

whereby a received frame may be transmitted from an input port to a determined output port and then onto the communication network based on the frame contained destination information without performing a table lookup operation to determine the output port.

2. The method of claim 1, wherein the step of receiving a frame at a first switch comprises reading a portion of a header of the frame and causing the frame to be passed directly to the output port without performing a table lookup operation.

3. The method of claim 1, wherein the frame contained destination information comprises a portion of a Media Access Control (MAC) address.

4. The method of claim 3, wherein the MAC address is a local destination MAC address.

5. The method of claim 3, wherein extracting comprises reading a field of the MAC address, the field of the MAC address being a selected number of bits of the MAC address smaller than the total number of bits of the MAC address and located at a particular location within the MAC address, and wherein ascertaining comprises using information in the field to identify the output port.

6. The method of claim 5, wherein ascertaining comprises reading at least a second field of the MAC address.

7. The method of claim 1, wherein the frame contained destination information comprises a local Media Access Control (MAC) address having at least two fields, a first of said fields containing information for the first switch and a second of said fields containing information for a second switch connected to an interface of the first switch.

8. The method of claim 7, wherein extracting comprises reading the first and second fields.

9. The method of claim 8, wherein ascertaining comprises comparing, by the first switch, information in the second field with expected information, and selecting as the output port an output port on the first switch that is connected to said second switch if the information in the second field does not match the expected information.

10. A protocol data unit data structure stored in a tangible computer readable medium, the protocol data unit data structure comprising:

a destination Media Access Control (MAC) address, the destination MAC address being a local MAC address having a plurality of fields, each of the fields including a number of bits smaller than a total number of bits of the destination MAC address, and each of the fields containing a code to be used by a switch on a network to identify an output port on the switch without performing a table lookup operation, wherein each of the fields is to be used by a different switch on the network; and

a payload portion.

11-14. (Canceled)

15. A method of assigning a Media Access Control (MAC) address to an interface on a network, comprising:

setting a local bit in the MAC address to indicate to network elements on the network that the MAC address is locally assigned; and

assigning a first value to a first field of the MAC address, the first field containing a smaller number of bits than a total number of bits of the destination MAC address, said first value containing first output interface information usable by a first switch to identify a first output interface for transmission of frames containing the first value in the first field of said MAC address.

16. The method of claim 15, further comprising collecting the first output interface information from the first switch.

17. The method of claim 15, further comprising assigning a second value to a second field of the MAC address, the second field containing a smaller number of bits than the total number of bits of the destination MAC address, said second value containing second output interface information usable by a second switch to identify a second output interface for transmission of frames containing the second value in the second field of said MAC address.

18. The method of claim 17, further comprising collecting the second output interface information from the second switch.

19. The method of claim 15, further comprising transmitting the MAC address to a network device containing said interface to which the MAC address has been assigned.

20. The method of claim 19, further comprising setting the network device in promiscuous mode to cause the network device to receive said MAC address.

21. The method of claim 15, further comprising a step of assigning a second field of the MAC address according to a prefix of the first switch.

22. The method of claim 21, wherein the prefix is a portion of all local MAC addresses that are reachable through the first switch.

23. (Canceled)

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/John C. Gorecki/
John C. Gorecki, Reg. No. 38,471

M.S. Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL LETTER

Transmitted herewith is an Appeal Brief. The fee has been calculated and is transmitted as shown below:

	Number of Claims Remaining After Amendment	Highest Number of Claims previously paid for	Number of Extra Claims Present	Rate	Additional Fee
Total Claims	18	23	0	x \$50.00	\$0
Independent Claims	3	3	0	x \$200.00	\$0
Applicants request a two month extension of time to file this Appeal Brief					\$460.00
Fee for filing Appeal Brief					\$510.00
TOTAL ADDITIONAL FEES FOR THIS AMENDMENT					\$970.00

A credit card authorization for the required fees is attached. If any additional fees are due, the Commissioner is hereby authorized to charge payment of the fees associated with this communication or credit any overpayment to Deposit Account No. 502246 (Ref. NN-14715). A duplicate copy of this sheet is enclosed.

Respectfully Submitted

Dated: September 30, 2008

/John C. Gorecki/
John C. Gorecki, Reg. No. 38,471

Anderson Gorecki & Manaras LLP
P.O. Box 553
Carlisle, MA 01741
Tel: (978) 264-4001
Fax: (978) 264-9119